Table 1. Summary of environmental investigations associated with marine sediments at the Harbor Island Superfund site and the West Waterway OU

1985 Preliminary Investigation - Phase 1	Black and Veatch 1985	Lower Duwamish Waterway East and West Waterways Elliott Bay	The Preliminary Investigation (PI) summarized existing literature regarding past site activities, the extent of sediment contamination around Harbor Island, and the potential need for additional data collection. The PI examined existing data to determine the nature and extent of sediment contamination; potential upland sources; ecological effects including toxicity, bioaccumulation, pathology, and benthic community structure; and potential concerns for human health. The PI did not identify any formal ecological risk assessments for the Harbor Island area, and no benthic data were identified for the West Waterway. However, the report summarized several area-wide studies that investigated ecological risk factors beyond sediment toxicity and bioaccumulation potential. None of the studies independently evaluated the West Waterway as a distinct location within the Duwamish River estuary. Given the age of the data, and lack of site-specific information, information from this report was not used for the risk management decisions for the West Waterway OU.
1988 Elliott Bay Action Program (EBAP)	PTI and Tetra Tech 1988	Lower Duwamish Waterway East and West Waterways Elliott Bay	In 1985, PTI and Tetra Tech collected environmental contamination and effects data within Elliott Bay and the lower Duwamish River to support the following EBAP objectives: to protect the marine and estuarine ecosystems from further degradation from anthropogenic inputs, identify degraded areas for remedial action, and protect recreational users. Sediments were collected at nineteen locations throughout Elliott Bay and the Duwamish River for chemical analysis, toxicity testing, and evaluation of benthic abundance. Fish were also collected for analysis of tissue chemistry. For the West Waterway, the EBAP study reported results for six amphipod (*Rhepoxynius abronius*) acute sediment toxicity bioassays within the area that is now defined as the West Waterway OU. None of the bioassays exceeded the CSL biological criterion for the amphipod bioassay. One of the bioassays exceeded the SQS biological criterion for the amphipod bioassay. The EBAP data were collected prior to promulgation of the Washington State Department of Ecology's Sediment Management Standards (SMS). Consequently, chemical and biological data are not sufficient to determine compliance with the SMS in the West Waterway. Additionally, 1985 data are generally considered outdated for use in making sediment risk management decisions.

1995 Harbor Island RI/FS, Part 2-Sediment *Fund-lead*	Weston 1994, 1995	Lower Duwamish Waterway East and West Waterways North Harbor Island (Elliott Bay)	In 1990, the EPA's Phase 1 remedial investigation for the Harbor Island Superfund site (Ebasco 1990) did not include studies on marine sediments adjacent to Harbor Island. Subsequently, EPA initiated a sediment remedial investigation for the Harbor Island site. In 1991, surface and subsurface sediment samples were collected and analyzed for chemistry and an *in situ* bioaccumulation study using caged mussels was performed. No biological toxicity testing was performed for the RI/FS. In 1995, the sediment RI/FS was completed. The RI/FS report summarized background information, characterized the nature and extent of sediment contamination, summarized the fate and transport of contaminants, estimated risk to human health and the environment, identified and prioritized areas for cleanup, and developed and evaluated cleanup alternatives. Preliminary clean-up goals were based on Washington State Sediment Management Standards (Chapter 173-204 WAC) sediment quality standards (SQS) and cleanup screening levels (CSL). Related technical memorandum: 1997 EPA Memorandum: Update on Activities related to Marine Sediments at the Harbor Island Superfund site 1997 EPA Memorandum: Errata and Modifications to the EPA RI/FS for sediments at the Harbor Island Superfund site
1995, 1996 Two Supplementary RI Studies *Pursuant to Administrative Order on Consent, dated February 13, 1995, No. 10-95-0130-CERCLA*	EVS and Hart Crowser 1995; EVS 1996	West and East Waterways North Harbor Island (Elliott Bay)	In 1995, additional sediment investigations were performed as part of the Harbor Island Supplementary Remedial Investigation (SRI) field sampling effort. This effort was conducted under a legal agreement between the EPA and several potentially responsible parties (PRPs). Additional sediment data were required primarily because the Harbor Island RI/FS did not adequately define the extent of surface sediments that may potentially warrant cleanup based on SMS chemical and biological criteria. For the SRI, surface and subsurface chemical data and surface sediment toxicity bioassay data were collected around Harbor Island, with 33 surface sediment stations located in the West Waterway.

1996 U.S. Army Corps of Engineers' Confined Aquatic Disposal (CAD) Site Study	SAIC 1996	West Waterway	The U.S. Army Corps of Engineers Seattle District created a CAD site in the Duwamish Waterway in 1984. Dredged sediments contaminated with PCBs were placed in a depression in the West Waterway and then capped, in part to demonstrate the feasibility of CAD technology. In 1995, an 11th-year monitoring survey was conducted to assess any potential cap degradation and the biological health of the re-colonized cap. The monitoring study included collecting 3 vibracore samples and 36 images as part of a sediment vertical profiling system (SVPS) survey. Results suggest that the CAD site provides a fair to moderate sediment quality for benthic infauna and that contaminants are not migrating through the cap.
1996 ARCO Environmental Study, Terminal 21T	Geraghty & Miller 1996	West Waterway	In 1995 and 1996, surface sediment sampling was conducted between the ARCO T-dock and the shoreline riprap in the West Waterway to evaluate potential sediment impacts from municipal outfalls located near the facility. Five locations were sampled during September 1995 and three locations during May of 1996. Samples were analyzed for metals, HPAHs, LPAHs, selected SVOCs, TPH compounds, and PCBs. No biological data were collected. The chemical data were evaluated in accordance with state Sediment Management Standards. PCBs were not detected in any outfall sediment sample, and PAHs and 6 metals were not found at concentrations above state SQS. Ecology determined that sediments are not impacted above levels that would cause adverse effects to aquatic life and that no additional sampling was necessary.
1996 Recommendations for Screening Values for Tributyltin in Sediments at Superfund Sites in Puget Sound, Washington	Weston 1996		An interagency workgroup comprised of EPA, Ecology, State Department of Natural Resources, U.S. Army Corps of Engineers, NOAA, EVS consultants, and Weston (EPA contractor) was formed to identify and evaluate various approaches to derive a marine sediment effects-based screening value or cleanup level for TBT in the absence of a federal or state regulatory standard. The effort was initiated to assist EPA in selecting sediment screening values and recommending a cleanup approach for assessing risks associated with TBT-contaminated sediments at Superfund sites in Puget Sound, WA.

1998, 1999 Human Health Risk Assessment and Studies on Tributyltin in Marine Sediments and Bioaccumulation of Tributyltin in Tissues of Marine Organisms *Pursuant to Administrative Order on Consent, dated May 4, 1998, No. 10-98-0087-CERCLA*	Various authors	Lower Duwamish Waterway West and East Waterways	These studies were undertaken to address potential concerns associated with three bioaccumulative compounds -- PCBs, TBT, and mercury -- previously detected at the site. In large part, these studies were conducted because: 1) there is no state sediment standard for TBT; and, 2) although sediments in the West Waterway OU "passed" the state SMS, those standards do not consider human health or bioaccumulative risks. The three major components of the study included: 1) performing a literature of tissue residue effects data for PCBs, TBT, and mercury in marine organisms; 2) assessing the potential ecological impacts associated with exposure to TBT in sediments; and, 3) performing a human health risk assessment (HHRA) to estimate potential risk associated with PCBs, TBT, and mercury that may have bioaccumulated from site sediments to fish and shellfish consumed from the West Waterway OU by people. The specific tasks undertaken included reviewing existing literature on tissue residue ecological effects data for the three contaminants of concern; chemical analysis (sediment and porewater) and bioaccumulation testing of West Waterway sediments for TBT; determination of a site-specific tissue trigger level for TBT; a review of seafood consumption surveys and relevant historical tissue data for PCBs, TBT, and mercury; collection of seafood tissue data and analysis for PCBs, TBT, and mercury; and, development of a conceptual site model and subsequent HHRA (seafood pathway). A re-evaluation of potential dermal risks to tribal net fishers was also performed. Specific reports include: 1998 Conceptual Site Model and Exposure Assessment - Assessing Human Health Risks from the Consumption of Seafood 1998 Sampling and Analysis plan for TBT Study 1998 Sampling and Analysis Plan - Assessing Human Health Risks from the Consumption of Seafood 1999 Review of Tissue Residue Effects Data for Tributyltin, Mercury, and Polychlorinated Biphenyls 1999 Tributyltin in Marine Sediments and Bioaccumulation of Tributyltin: Combined Data Report 1999 Human Health Risk Assessment - Assessing Human Health Risks from the Consumption of Seafood 1999 EPA Technical Memorandum - Topics Related to the TBT Field Study at the Harbor Island Superfund Site 1999 EPA Letter - Tribal Net Fisher Scenario, Human Health Risk Assessment, Harbor Island Superfund Site

2002 Updated Risk Assessment Information for the West Waterway Operable Unit of the Harbor Island Superfund Site, Seattle, Washington	EPA 2002	West Waterway	EPA completed a technical memorandum that provided a status of ongoing actions at the Harbor Island Superfund site; summarized existing data and risk characterization results for the West Waterway OU; incorporated additional human health risk assessment characterization based on Suquamish Tribe consumption survey ingestion rates and risk assessment assumptions from the Phase 1 risk assessment of the Lower Duwamish Waterway Superfund site; presented a range of risks for the consumption of seafood; and, provided responses to concerns raised by stakeholders.

Table 2. Completed and ongoing cleanup actions at the Harbor Island Superfund site and surrounding areas

Harbor Island Soil/Groundwater OU (1993 EPA Record of Decision)

- Completed excavation and offsite disposal of PCB-contaminated soils (Seattle Iron and Metals) and other "hot spots" of contaminated soils.
- Completed capping of exposed soils exceeding cleanup goals.
- Ongoing excavation and onsite treatment of "hot spots" of petroleum-contaminated soils at Todd Shipyards.
- Ongoing removal and treatment of floating petroleum product and contaminated groundwater at Todd Shipyards.
- Determination that contaminated groundwater at the site, with the exception of Todd Shipyards and the Petroleum Tank Farms (see below), is an insignificant source to sediments.

Harbor Island Upland Lockheed Shipyard OU (1994 EPA Record of Decision)

- Excavation of "hot spots" of petroleum-contaminated soils; capping of soil; and long-term monitoring of groundwater. Deleted from Superfund list in 1996.

Harbor Island - Other Source Control (in accordance with Superfund authorities)

- Removal of all sediments in Harbor Island public storm drain system; identification and correction of illegal connections; determination that storm drains no longer considered to be a significant source of contamination to sediments (completed 1990).
- Value Metal Plating cleanup (completed 1992).
- Determination that private storm drains on Harbor Island were not considered to be significant sources of contamination to sediments (completed 1993).

Harbor Island - Petroleum Tank Farms OU, State Lead (in accordance with State of Washington cleanup authorities)

-Under a Memorandum of Agreement between EPA and Ecology, EPA designated Ecology the lead agency for the tank farms because petroleum is the primary contaminant of concern. Petroleum is excluded from Superfund regulations, but is regulated as a hazardous substance under the State of Washington Model Toxics Control Act.
-Tank farms include: Shell (formerly Equilon and Texaco); BP-ARCO; and Kinder Morgan (formerly GATX and Shell Oil).
-For Shell, an Ecology cleanup action plan and consent decree were finalized in April 1999. The cleanup plan includes contaminated soil excavation, groundwater cleanup and soil vapor extraction, and long-term monitoring. To date, excavation and removal of TPH-contaminated soil (and some lead and arsenic-contaminated soil) has been partially completed. Operation of the remedial system, monitoring, and data collection are ongoing.

-For Kinder Morgan, an Ecology cleanup action plan and consent decree were finalized in April 2000. The cleanup plan includes free product recovery and installation of a barrier to prevent migration, air sparging, excavation of accessible TPH, lead, and arsenic-contaminated soil, and long-term monitoring. To date, the free product recovery and air sparging systems have been constructed and are now in operation. All accessible contaminated soil has been excavated and removed in the B and C yards. Monitoring and data collection are ongoing. GATX is not located near the shoreline.
-For BP-ARCO, an Ecology cleanup action plan and consent decree were finalized in March 2000. The cleanup plan includes expanding a product recovery system at the terminal bulkhead and adding soil vapor extraction and air sparging, excavation of accessible TPH-contaminated soil, and long-term monitoring. All accessible contaminated soil has been excavated and removed. Monitoring and data collection are ongoing.

Lockheed and Todd Shipyard Sediment OUs (1996 EPA Record of Decision; 2002 and 2003 Lockheed ESDs; 1999 and 2003 Todd ESD)

- Contaminated sediments Ecological risk drivers are arsenic, copper, lead, mercury, zinc, and TBT.
- Todd and former Lockheed Shipyards. For the Lockheed Shipyard Sediment OU, cleanup will begin in 2003 and will include removal of 6,000 pilings, dredging of an estimated 130,000 cy of sediments, capping of an estimated 4 acres, and partial filling of a shipway and associated mitigation. For the Todd Shipyard Sediment OU, cleanup will include removal of 2,000 pilings, dredging of an estimated 200,000 cy sediments, pier reconfiguration, and capping under pier structures that remain in place.

Harbor Island East Waterway OU

- EPA is currently planning how best to implement East Waterway remediation under Superfund authorities in coordination with the Port of Seattle's proposal to dredge the East Waterway for navigational purposes.

Pacific Sound Resources Superfund Site (1999 ROD)

- PAH-contaminated sediments over approximately 50 acres. Cleanup will begin in 2003. Human health risk (seafood consumption) is not a driver. Post-cleanup residual human health risk estimated to be 1×10^{-5}.

Lower Duwamish Waterway (LDW) Superfund Site

- Study area includes approximately 6 miles of the lower Duwamish Waterway. Estimates for the scoping phase RI to be completed in early 2003, with early cleanup work initiated in 2003. Baseline risk assessments planned for 2004, with a ROD planned for 2004 or 2005 for the LDW.

Table 3. Total PCBs, Total Mercury, and TBT (Ion) Concentrations for Proposed Target Fish and Shellfish Species Collected During Previous Studies from 1990 to 1998, Excerpted from the Human Health Risk Assessment.

	Concentration Statistics - Mean (Max, Min, SD, N)[a]				
	Total PCBs (µg/kg wet weight)				
Species	Lower Duwamish	West Waterway	East Waterway	Elliott Bay	Reference [b]
Chinook salmon	**56** (161, 18, 28, 31)[c]	na	na	na	**48** (212, 5.0, 33, 117)[c]
Coho salmon	**26** (46, 9.0, 9.0, 24)[c]	na	na	na	**25** (126, 4.7, 20, 115)[c]
Shiner perch	**500** (620, 356, 134, 3)[c,d]	na	na	**200** (262, 138, 62, 3)[c,d]	**70** (102, 53, 27, 3)[c,d]
English sole	**192** (365, 81, 83,12)[c]	**336** (462, 262, 110, 3)[c]	**560** (643, 412, 128, 3)[c]	**71** (447, 6.3, 80, 73)[c]	**12** (76, 2.3, 11, 198)[c]
Dungeness crab	**157** (177, 138, –, 2)[c]	na	na	**118** (278, 12, 115, 4)[c]	**8.0** (8.0, 8.0, 0, 3)[c]

	Total Mercury (µg/kg wet weight)				
Species	Lower Duwamish	West Waterway	East Waterway	Elliott Bay	Reference
Chinook salmon	**102** (150, 59, 27, 18)	na	na	na	**90** (160, 51, 25, 82)
Coho salmon	**41** (53, 25, 8, 18)	na	na	na	**50** (110, 26, 17, 88)
Shiner perch	**78** (88, 71, 9, 3)[d]	na	na	**29** (30, 27, 1.6, 3)[d]	**70** (106, 41, 33, 3)[d]
English sole	**53** (83, 20, 23, 12)	**23** (29, 20, 5.3, 3)	**30** (34, 26, 4.2, 3)	**69** (129, 24, 28, 72)[c]	**51** (130, 17, 19, 191)
Dungeness crab	**100** (111, 90, –, 2)	na	na	**87** (128, 58, 34, 4)	**63** (69, 53, 8.5, 3)

	TBT (ion) (µg/kg wet weight)				
Species	Lower Duwamish	West Waterway	East Waterway	Elliott Bay	Reference
Chinook salmon	na	na	na	na	na
Coho salmon	na	na	na	na	na
Shiner perch	**153** (179, 118, 31, 3)[d]	na	na	**126** (174, 102, 41, 3)[d]	**32** (46, 16, 15, 3)[d]
English sole	**2.6** (5.7, 0.37, 2.5, 6)[c]	**1.4** (2.1, 0.34, 0.93, 3)[c]	**1.3** (1.9, 0.34, 0.82, 3)[c]	**0.40** (2.0, 0.06, 0.64, 12)[c]	**0.32** (0.36, 0.27, 0.04, 3)
Dungeness crab	**64** (82, 47, –, 2)	na	na	**32** (79, 1.6, 40, 5)	**2.5** (3.0, 2.2, 0.45, 3)

SOURCES: King County Department of Natural Resources (1999); O'Neill pers. comm. (1998); Weston (1998); Port of Seattle unpublished data collected in 1996

NOTE: All fish samples were composites of skinless filets unless otherwise noted; all shellfish samples were edible muscle meat; all samples uncooked
All concentrations (including total PCBs) calculated assuming one-half detection limit for non-detect samples
No data available for Upper Duwamish study area section (not shown on table)
All total PCB concentrations include at least one detected Aroclor
na - not available

[a] Number in bold is mean concentration; numbers in parentheses are, in order, maximum concentration (Max), minimum concentration (Min), standard deviation (SD), and number of samples analyzed (N).

[b] Reference areas are shown in Appendix B (Figure B-1).

[c] Summary statistics include one or more non-detect values.

[d] Shiner perch samples were whole-body.

Table 4. Sediment ingestion (exposure factors), excerpted from the RI.

$$CDI_{ingestion} = C_{sediment} \times \frac{IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Parameters	Exposure Factor	Value
$C_{sediment}$	**Concentration of Contaminant in Sediment (mg/kg)** Upper 95% confidence limit of the arithmetic mean.	Site-specific
IR	**Ingestion Rate (mg/day)** The ingestion rate of 75 mg/day assumes that people fishing work double shifts during half of the 7-month season and single shifts the other half. (Best professional judgement, based on the EPA default ingestion rate for industrial workers of 50 mg/day.)	75
CF	**Conversion Factor (kg/mg)**	1.0E-06
FI	**Fraction Ingested from Contaminated Source (unitless)** The fraction assumes all exposure is received at work.	1.0
EF	**Exposure Frequency (days/year)** The exposure frequency assumes people work every day for the extended season of 7 months (210 days).	210
ED	**Exposure Duration (years)** The exposure duration is 25 years, the EPA standard industrial default.[a]	25
BW	**Body Weight (kg)** The adult body weight is the EPA standard default of 70 kg.[a]	70
AT	**Averaging Time (days)** The averaging time for noncancer risk is 25 years x 365 days/year. The averaging time for cancer risk is 70 years x 365 days/year.[a]	9,125[b] 25,550[c]
Noncarcinogenic Incidental Sediment Ingestion Summary Intake Factor[d]		6.2E-07
Carcinogenic Incidental Sediment Ingestion Summary Intake Factor[d]		2.2E-07

Note: $CDI_{ingestion}$ represents the chronic daily intake of ingested sediment.

[a] *EPA. 1991. Supplemental Risk Assessment Guidance for Superfund,* U.S. Environmental Protection Agency, Region X, Seattle, Washington. 16 August 1991.

[b] Noncancer risk.

[c] Cancer risk.

[d] Chronic daily intake estimate assuming contaminant concentration in sediment of 1 mg/kg (units of mg/kg-day).

Table 5. Dermal contact with sediment (exposure factors), excerpted from Appendix D of the RI.

$$\text{Absorbed Dose} = C_{sediment} \times \frac{ABS \times CF \times SA \times AF \times FC \times EF \times ED}{BW \times AT}$$

Parameters	Exposure Factor	Value
$C_{sediment}$	**Concentration of Contaminant in Sediment (mg/kg)** Upper 95% confidence limit of the arithmetic mean.	Site-specific
ABS	**Percutaneous Absorption Factor (unitless ratio)**	Contaminant-specific[a]
CF	**Conversion Factor (kg/mg)**	1.0E-06
SA	**Surface Area Available for Contact (cm^2)** An exposed surface area of 3160 cm^2 was based on the head, hands, and forearms, which assumes that workers wear full rain gear but no gloves.[b]	3,160
AF	**Soil to Skin Adherence Factor (mg/cm^2)** The soil to skin adherence factor is 1.0 mg/cm^2, the EPA-recommended reasonable upper value.[c]	1.0
FC	**Fraction Contacted from Contaminated Source (unitless)** All contact is assumed to occur while fishing.	1.0
EF	**Exposure Frequency (days/year)** The exposure frequency assumes people are working every day for the extended season of 7 months (210 days).	210
ED	**Exposure Duration (years)** The exposure duration is 25 years, the EPA standard industrial default value.[d]	25
BW	**Body Weight (kg)** The adult body weight is the EPA standard default of 70 kg.[d]	70
AT	**Averaging Time (days)** The averaging time for noncancer risk is 25 years x 365 days/year. The averaging time for cancer risk is 70 years x 365 days/year.[d]	9,125[e] 25,550[f]
Noncarcinogenic Dermal Contact Intake Factor[g]		2.6E-05 x ABS
Carcinogenic Dermal Contact Intake Factor[g]		9.3E-06 x ABS

[a] Table 6-7—Fractional Percutaneous Absorption for Dermal Exposure.
[b] *Exposure Factors Handbook (EPA 1989c).*
[c] *Dermal Exposure Assessment: Principles and Applications* (EPA 1992a).
[d] *Supplemental Risk Assessment Guidance for Superfund* (EPA 1991b).
[e] Noncancer risk.
[f] Cancer risk.
[g] Absorbed dose estimate assuming a contaminant concentration in sediment of 1 mg/kg (units in mg/kg-day).

Table 6. Excess cancer risk characterization due to sediment contact for West Waterway.

Contaminant	Cancer Risk		
	Incidental Ingestion	Dermal Contact	Total Risk (across both pathways)
Bis(2-ethylhexyl)phthalate	1.4E-08	3.4E-08	4.8E-08
PAHs[a]	3.2E-06	NA	3.2E-06
Heptachlor	2.2E-09	5.5E-09	7.7E-09
PCBs[b]	2.8E-07	3.6E-07	6.5E-07
Arsenic	7.9E-06	NA	7.9E-06
Beryllium	1.5E-07	NA	1.5E-07
Total Risk	1.2E-05	4.0E-07	1.2E-05

NA Not applicable for this pathway.

[a] Sum of all carcinogenic PAHs using the TEF approach discussed in Section 3.1 of Appendix D. PAHs included in the total are benzo(a)pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene. Risks associated with individual carcinogenic PAHs presented in the risk calculation spreadsheets (Appendix D).

[b] Sum of PCBs detected in sediment: Aroclor-1248, Aroclor-1254, and Aroclor-1260.

Table 7. Noncancer risk characterization due to sediment contact for West Waterway.

Contaminant	Hazard Quotients		Total Hazard Index (across all pathways)
	Incidental Ingestion	Dermal Contact	
Bis(2-ethylhexyl)phthalate	0.00014	0.00034	0.00048
Heptachlor	0.0000027	0.0000069	0.0000096
Arsenic	0.041	NA	0.041
Beryllium	0.000020	NA	0.000020
TBT	0.053	0.14	0.19
Total Hazard Index	0.095	0.14	0.23

NA Not applicable for this pathway.

Table 8. Values used for daily intake calculations for fish and shellfish consumption pathway.

Scenario Timeframe: Current/future
Medium: Sediment
Exposure Medium: Animal tissue
Exposure Point: Fish and shellfish
Receptor Population: Fisher
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	EPC	Exposure point concentration in fish or shellfish	µg/kg	Table 4-3	–	Table 4-3	–	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-F	Ingestion rate - fish[a]	g/day	105[b]	Toy et al. 1996	31	Ecology 1999, based on Landolt et al. 1985	EPC x IR x FI x FR x EF x ED x CF1 x CF2 x 1/BW x 1/AT
	IR-S	Ingestion rate - shellfish[a]	g/day	61[c]	Toy et al. 1996	5[d]	Toy et al. 1996	
	FI	Fraction ingested (by species)	unitless	Table 4-2	see text	Table 4-2	see text	
	FR	Fraction ingested from site	unitless	1	see text	1	see text	
	EF	Exposure frequency	days/year	365	see text	365	see text	
	ED	Exposure duration	years	30	USEPA 1991a	9	USEPA 1991b	
	CF1	Conversion factor	kg/g	0.001	–	0.001	–	
	CF2	Conversion factor	mg/µg	0.001	–	0.001	–	
	BW	Body weight	kg	70	USEPA 1991a	70	USEPA 1991a	
	AT-C	Averaging time - cancer	days	25,550	USEPA 1989	25,550	USEPA 1989	
	AT-N	Averaging time - noncancer	days	10,950	USEPA 1989	3,285	USEPA 1989	

SOURCE: Standard Table 4 in USEPA (1998a)

NOTE: CT - central tendency
RME - reasonable maximum exposure

[a] Consumption rates based on wet weights as consumed prior to cooking; preparation methods differ between individuals; see Appendix A and source documents for more information.

[b] 95th percentile total finfish consumption rate for both tribes combined from Toy et al. (1996, Table 3) adjusted to account for fishing within Puget Sound only (multiplied by fraction of 0.687; see Appendix Table F-1)

[c] 95th percentile shellfish consumption rate for both tribes combined from Toy et al. (1996, Table 3) adjusted to account for fishing within Puget Sound only (multiplied by fraction of 0.669; see Appendix Table F-1).

[d] Median shellfish consumption rate for both tribes combined from Toy et al. (1996, Table 3) adjusted to account for fishing within Puget Sound only (multiplied by fraction of 0.669; see Appendix Table F-1).

Table 9. Total PCB concentrations measured from stations located within the West Waterway OU

Study	Sample Depth	Stations in West Waterway OU	Minimum	Median	Maximum	# exceeding SQS (12 mg/kg OC)	# exceeding CSL (65 mg/kg OC)
RI/FS (Weston 1995)	0 to 2 cm	33	0.0 (mg/kg OC) 0.0 (µg/kg dw)	5.2 (mg/kg OC) 92 (µg/kg dw)	34.2 (mg/kg OC) 467 (µg/kg dw)	9	0
SRI (EVS and Hart Crowser 1996)	0 to 10 cm	25	6 (mg/kg OC) 91 (µg/kg dw)	14.4 (mg/kg OC) 290 (µg/kg dw)	81.1 (mg/kg OC) 1460 (µg/kg dw)	21	1

Note: Total PCBs were summed using a value of zero for undetected individual Aroclor values, which is the approach recommended by Washington State and the Puget Sound Dredged Disposal Analysis program. Maximum values are less when the outlier is deleted (e.g., for the supplementary RI, the next highest value is 43.9 ppm-oc total PCBs (compared to the maximum of 81 ppm-oc total PCBs).

Table 10. Final risk estimates for the seafood ingestion pathway for the West Waterway OU (first row) and comparison risk estimates using alternative input parameters

	Percent Seafood Consumed from West Waterway OU	Exposure Duration	Ingestion Rate	Excess Cancer Risk[13]
Risk Estimates Based on Tulalip/Squaxin Study Ingestion Rates (from Proposed Plan)	10% to 100% (The final risk assessment for the West Waterway OU assumed 100% of all Puget Sound caught seafood was consumed from the West Waterway OU = 1×10^{-4}).	30 yr	76.5 g/day	1×10^{-5} to 1×10^{-4}
Comparison 1				
Risk Estimates Based on the Suquamish Study Ingestion Rates	10% to 100% (An addendum to the final risk assessment for the West Waterway OU assumed 100% of all Puget Sound caught seafood was consumed from the West Waterway OU).	30 yr	33.9 g/day	5×10^{-6} to 5×10^{-5}
Comparison 2				
Risk Estimates Based on Suquamish Study Ingestion Rates used for the LDW Scoping Phase	100%	30 yr (used for WWOU) to 55 yr (used for LDW)	84 g/day	2×10^{-4} to 3×10^{-4}

Note: These ingestion rates are based on tribal consumption surveys. The tribal ingestion rates exclude anadromous fish, such as salmon, and excludes seafood consumed at restaurants, from the grocery store, and from areas outside of Puget Sound. King County data estimate a non-tribal seafood ingestion rate for the Duwamish River at approximately 3 g/day.

13. Given the uncertainties inherent in the risk assessment process, emphasis is placed on order of magnitude risk (e.g., 10^{-4} or 10^{-5}) when determining whether action is warranted under Superfund. EPA guidance indicates that the upper boundary of the risk range is not a discrete line at 1×10^{-4}, and given site-specific conditions, EPA can consider risk estimates slightly greater than 1×10^{-4} to be protective. Therefore, given site-specific conditions for the West Waterway OU, the risk estimates of 2×10^{-4} and 3×10^{-4} are within Superfund's acceptable risk range of 10^{-4} to 10^{-6} and action is not warranted under CERCLA.